

NEC-2370-US
Amendment dated 05/19/2004

09/853,622

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Reply to office action mailed 04/21/2004

REMARKS

Claims 1-21 are currently pending in the application, with claims 4-21 having been withdrawn from consideration as being drawn to non-elected inventions or species, there being no allowable generic or linking claim. By this amendment, claims 1 and 3 are amended for the Examiner's consideration. The foregoing separate sheets marked as "Listing of Claims" shows all the claims in the application, with an indication of the current status of each.

The Examiner has objected to certain informalities in the drawings. In particular, the Examiner has indicated that the Lower Shield 1 shown in the drawings must also show the "... alloy, as a base" set forth in the claims. However, the supporting language in the specification (at page 24, lines 5-7) is as follows:

"In particular, it is preferable that the lower shield be made of a material based on CoZrTa and CoZrTaCr alloy." (emphasis supplied)

Thus, the word "base" in the claim language was intended to refer to the chemical composition use of that term ("based"), rather than the mechanical layering sense used elsewhere in the specification ("base"). The confusion stems from a syntactical ambiguity in translation. Consequently, the claim language has been amended to conform to the intended meaning, thereby overcoming the objection. No amendment to the drawings is required.

Also, the Examiner has pointed out that the reference signs "13: BASE LAYER/ 10: FREE LAYER" in Figs. 1 and 4-6 are not mentioned in the description. It will be noted that the figures show "8: BASE LAYER/ 3: FREE LAYER" in reference to a layer below or at the bottom of "a shielded-type magnetoresistive effect element 25 using a magnetoresistive effect film 20" (page 14, lines 11-12; Figs. 1 and 4-8). It will also be noted that in some of these figures (Figs. 1 and 4-5) the configuration includes the free layer as part of the magnetoresistive effect film (page 16, lines 1-3) and the reference signs "13: BASE LAYER/ 10: FREE LAYER"

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indicate a separate “base layer/ free layer” patterned on vertical bias layer 9. In contrast, Fig. 6 shows “a variation on Fig. 5, wherein the base layer 8 and free layer 3 are patterned onto the vertical bias layer” (page 19, lines 7-9). As shown in Figs. 6 and 7, in this configuration the “base layer/ free layer” is shown as one, merging the areas designated separately (i.e. “13: BASE LAYER/ 10: FREE LAYER”) in the earlier figures. The paragraph in the specification beginning at page 16, line 1 has been amended accordingly, thereby overcoming the objection. Additional reference signs have been added appropriately for the separate “base layer/ free layer” at page 16, line 14, and page 17, line 8. No new matter has been added.

The Examiner has noted several places in the specification where reference signs do not correctly correspond with those shown in the figures. These correspondences have been corrected by amendment to the specification. In particular, in line 16 on page 15, the item number for the “lower gap layer” has been corrected; in line 18 on page 15, and in lines 1-2, 9, 24 and 26-27 on page 16, the item numbers for “base layer” and “free layer” have been corrected.

The Examiner has also indicated that the item number for “upper shield” in lines 17 and 21 on page 18 should be corrected. However, upon review of the figures and the specification, the discussion in the text pertains not to Fig. 1 but to Fig. 3, and therefore the existing “upper shield 12” designation is correct. As will be observed, many of the subsequent embodiments (e.g. Figs. 3, 4, 5, 6 and 8) are described with reference to the description of Fig. 1. The above amendments to the specification include clarifications so that reference signs pertaining to Fig. 1 are not confused with reference signs pertaining to other figures. It will also be observed that the paragraph beginning at line 28 of page 18 has been rewritten to correspond to what is shown in Figs. 4 and 5.

For the foregoing reasons and also to correct errors in spelling and syntax, the specification has been amended at paragraphs beginning at page 1, line 19; page 2, line 8; page 3, line 22; page 6, line 5; page 6, line 18; page 9, line 10; page 10, line 4;

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page 15, line 15, and continuing to page 17, line 14; page 18, line 11, and continuing to page 18, line 21; page 18, line 24, and continuing to page 19, line 14; page 21, line 8; page 23, line 23; page 26 line 6; page 27 line 15; page 28 line 21; page 29 line 7; and page 33 line 5. No new matter has been added.

Fig. 6 has been amended in conformity with the above discussion to change the reference signs for the “base layer/ free layer” from {13,10} to {8,3}. Also, Fig. 11(B) has been amended to correct the spelling of “SHIELD.”

The Examiner has objected to the title as not being descriptive. The title has been amended to better conform to the invention as described in the specification and claimed as amended herein.

The Examiner has rejected claims 1-3 under 35 U.S.C. §112, second paragraph, as being indefinite with regard to references for “said fixed layer” in line 8 of claim 1 and “said barrier layer” in lines 8-9 of claim 1. The intended meaning, evident throughout the specification, is to provide for both orderings of the free layer, barrier layer and fixed layer: free/barrier/fixed and fixed/barrier/free. The claims have been amended to clarify this intended meaning so as to avoid the indefinite references noted by the Examiner, thereby overcoming this ground of rejection.

The Examiner has rejected claim 1 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,898,548 to Dill et al. (“Dill”). Dill discloses an MR read head having sense leads sufficiently thin to achieve high areal density by reducing the spacing between the magnetic shields. A magnetic tunnel junction device is located between two spaced-apart magnetic shields, which also function as electrical leads for connection of the head to sense circuitry. By contrast, the present invention provides a technology of magnetoresistive sensors for making the surface roughness of the barrier layer small (page 7, lines 19-21), primarily by forming a layer below the barrier layer as smooth and flat as possible (page 10, lines 4-7) and by limiting the crystal grain diameter in that layer and any intervening layers (page 10, lines 13-15). The technical explanation for the adverse affect of surface roughness of

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the barrier layer on the operation of the magnetoresistive sensor is described with reference to Fig. 2 at page 5, line 13, to page 6, line 17.

Consequently, the title and the claims have been amended to clarify the importance to the invention of smoothing the barrier layer by smoothing the layers below, whose roughness is inherited by the barrier layer. There is no recognition in Dill of the significance of surface roughness of the barrier layer, nor disclosure of technology beyond the prior art for reducing this surface roughness by smoothing the layers below. Thus, Dill fails to anticipate the present invention, as reflected in the amended claims.

The Examiner has also rejected claims 1 and 3 under 35 U.S.C. §102(a) as being anticipated by U.S. Patent No. 6,452,204 to Ishiwata et al. ("Ishiwata"). Ishiwata discloses a tunneling magnetoresistance (TMR) transducer capable of suppressing the thermal asperity problem, i.e. the increase in temperature of the GMR head where the gap between the GMR head and a magnetic medium is less than about 40 nm. Ishiwata provides a TMR transducer where the resistance of the barrier layer remains essentially constant independent of the temperature of the transducer. This is achieved by adjusting the pressure of oxygen (col. 4, lines 44-45; col. 7, lines 65-66) or nitrogen (col. 6, lines 14-15) and the substrate temperature. While Ishiwata indicates that the thermal asperity problem may be avoided by specially smoothing the surface of the magnetic medium (col. 1, lines 50-52), and that a prior art TMR produced by growing alumina on an aluminum layer by an oxygen glow discharging process (col. 2, lines 1-2) makes control of the thickness of the tunnel barrier layer difficult (col. 2, lines 18-19), there is no disclosure of either the significance of roughness of layers underlaying the barrier layer or technology for controlling and reducing this roughness.

Consequently, Ishiwata fails to anticipate the present invention, as reflected in the amended claims.

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The Examiner has rejected claim 2 under 35 U.S.C. §103(a) as being unpatentable over Dill. The argument presented by the Examiner is that one of ordinary skill in the art would have been motivated to lower the shield crystal grain diameter below 6.2 nm because a) such lowering “is generally achievable through routine optimization” and b) discovering the optimum or workable ranges where the general conditions of a claim are disclosed in the prior art is routine. However, as indicated above, Dill fails to disclose or suggest the significance of roughness of the barrier layer or the effect upon that roughness of the roughness of the lower shield layer. As amended, claim 1 now includes these aspects of the invention as “general conditions” that are inherited by claim 2. Consequently, since there is no disclosure in the prior art of these “general conditions,” there is no motivation to measure (much less seek optimization of) localized variation in TMR junction resistance and voltage (page 5, lines 28-29). The rejection is therefore overcome.

In view of the foregoing, it is requested that the application be reconsidered, that claims 1-3 be allowed, and that the application be passed to issue.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at 703-787-9400 (fax: 703-787-7557; email: clyde@wcc-ip.com) to discuss any other changes deemed necessary in a telephonic or personal interview.

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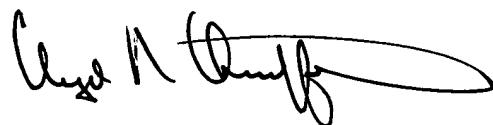
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If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2041.

Respectfully submitted,



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